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LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES
New Orleans, Louisiana

A SURVEY OF THE RECREATIONAL SHRIMP AND FINFISH HARVESTS OF THE VERMILION BAY AREA AND THEIR IMPACT ON COMMERCIAL FISHERY RESOURCES

by
CONRAD L. JUNEAU, JR.
and
JUDD F. POLLARD

Technical Bulletin No. 33

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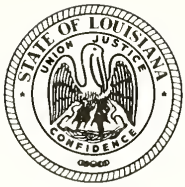

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Abstract

A creel survey was conducted within a portion of Vermilion Bay, Louisiana, that included data on both finfish and shrimp. Data collected included instantaneous counts and pertinent information from field interviews. Effort, catch per hour, and harvest were calculated for both recreational and commercial finfishermen and shrimpers. Comparisons of catch, effort, and harvest were also made among user groups and how each related to the resource. Recommendations are made concerning the management of the associated fisheries.

INTRODUCTION

An investigation of the recreational shrimp and finfish harvests of the Vermilion Bay area affords a means of obtaining information necessary to determine what impact such harvests have upon the resource. This investigation was designed to determine what portion of the shrimp and finfish harvests is recreational, and what effects recreational harvests have on these resources.

Very little research has been published in Louisiana regarding catches by the two main user groups, recreational and commercial fishermen. The National Marine Fisheries Service (NMFS) collects commercial fishery statistics with assistance from the states. Estimates of recreational fisheries harvest are also collected by NMFS. These data are obtained by telephone surveys of random households and depend on fishermen's recall. The first survey was conducted in 1960, and they have been conducted every five years since. Recreational fishermen may be defined as fishermen seeking particular species for fun or for home consumption (Figures 1 and 2). Recreational fishermen may also, on certain occasions when catches are substantial, sell all or a portion of their catch. A recreational fisherman, does not, however, begin an engagement with the intention of selling his catch; he does not depend on such sales for all or part of his livelihood. Commercial fishermen, in contrast, intend to sell their catch from the time the trip is planned (Figure 3); they depend upon such sales for a substantial percentage of their income.

With the advent of more efficient gear (Figures 4 and 5), larger and better boats and vessels, and a continuously increasing entry, it eventually became more important to estimate harvest and effort for each group. St. Amant (1979) discussed effects of competition among user groups, especially among boats fishing different count sizes of shrimp. His most obvious questions apply to any commercially important species and, concerning competition between user groups, ask which are the best returns and to whom should they apply. In other words, should management policies lean toward economics or demand? Data regarding recreational harvest have always been insufficient; this study however, provides information vital for the consideration of future management policies.

The general objectives of this study were to gather data on catches of recreational and commercial shrimpers and finfishermen and to determine what effect each had upon the resource. Christmas and Etzold (1977), in a regional shrimp management plan for the Gulf of Mexico, reported that recreational shrimping data were lacking, and such data are necessary for proper management. In its proposed management plan for the shrimp fishery of the Gulf of Mexico, the Gulf of Mexico Fisheries Management Council (1980) regarded conflicts among various user groups in the shrimp fishery as a growing problem.

Conflicts involving commercial and recreational finfishermen have increased, causing additional problems for resource managers. These conflicts have increased along the entire Gulf Coast over the last few years, as space became more limited and entry became larger. Other areas have also experienced similar problems, and no coastal fishing grounds seem to be immune (McHugh, 1977, Hopkins and Petrocelli, 1975). Other factors that limited production or harvest of finfish also contributed to the conflict. Petrocelli and Anderson (1973) reported a decline in many commercial and sport fish populations because of a decrease in spawning rates caused by the presence of pesticides in estuarine areas. Spotted seatrout and red drum were noticeably affected. Habitat change and loss were also major contributing factors (Hopkins and Petrocelli 1975).

A sound management policy is one that involves all phases of the shrimp and finfishing industry, whether commercial or recreational, and requires the accumulation of sound, useful data. Data may be provided by sampling, investigating, surveying, studying, or by any method or combination of methods by which a system may be investigated thoroughly. In this study, we used a creel survey for the principal species of finfish and shrimp (Figure 6).

AREA DESCRIPTION

Vermilion Bay is located along the western edge of the central Louisiana coast (Figure 7). It is a large, open body of water comprising approximately 121,604 acres, not including the several smaller lakes, bays, bayous, etc., surrounding it (Barrett 1970). The study area proper contains about one-half of this total, or approximately 61,000 acres of surface water. Vermilion Bay is the westernmost boundary of the Deltaic Plain and the easternmost edge of the Cheniere Plain (Coleman 1966).

Several other bodies of water directly affect environmental, hydrological, and bottom conditions in Vermilion Bay. The most influential is the Atchafalaya River, which discharges silt-laden water at the average rate of 242,583 cubic feet per second per annum into Atchafalaya Bay, East and West Cote Blanche Bays, Vermilion Bay, and the Gulf of Mexico. The Atchafalaya River also causes extremely low salinities and lower average water temperature than other areas along the Louisiana coast (Perret et al. 1971, and Juneau and Barrett 1975). The Vermilion River provides freshwater influx to the bay area. Southwest Pass at Marsh Island is probably the most influential source of salt water for Vermilion Bay. Southwest Pass is also unique in that it is wedged between Marsh Island and the mainland at the southwestern end of Vermilion Bay, and in several areas, depths exceed 100 feet. The greatest depth at Southwest Pass is 175 feet, near the point at which it joins the Gulf of Mexico. This is indeed unique be-

Figure 1. Angler fishing reef within study area.

Figure 2. Angler fishing within study area.

Figure 3. Commercial shrimp boat in port.

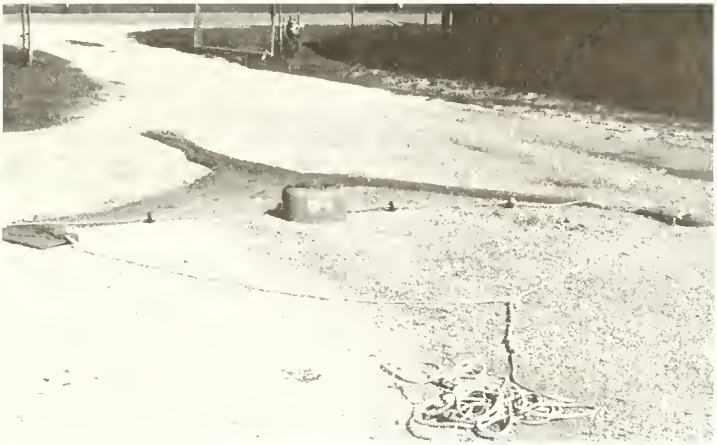

Figure 4. Sixteen-foot trawl, a gear commonly used by all shrimpers. Such trawls are often used as test nets.

Figure 5. Forty-foot otter trawl, a gear commonly used by both commercial and recreational trawlers.

Figure 6. Creel survey unit in the process of interviewing.

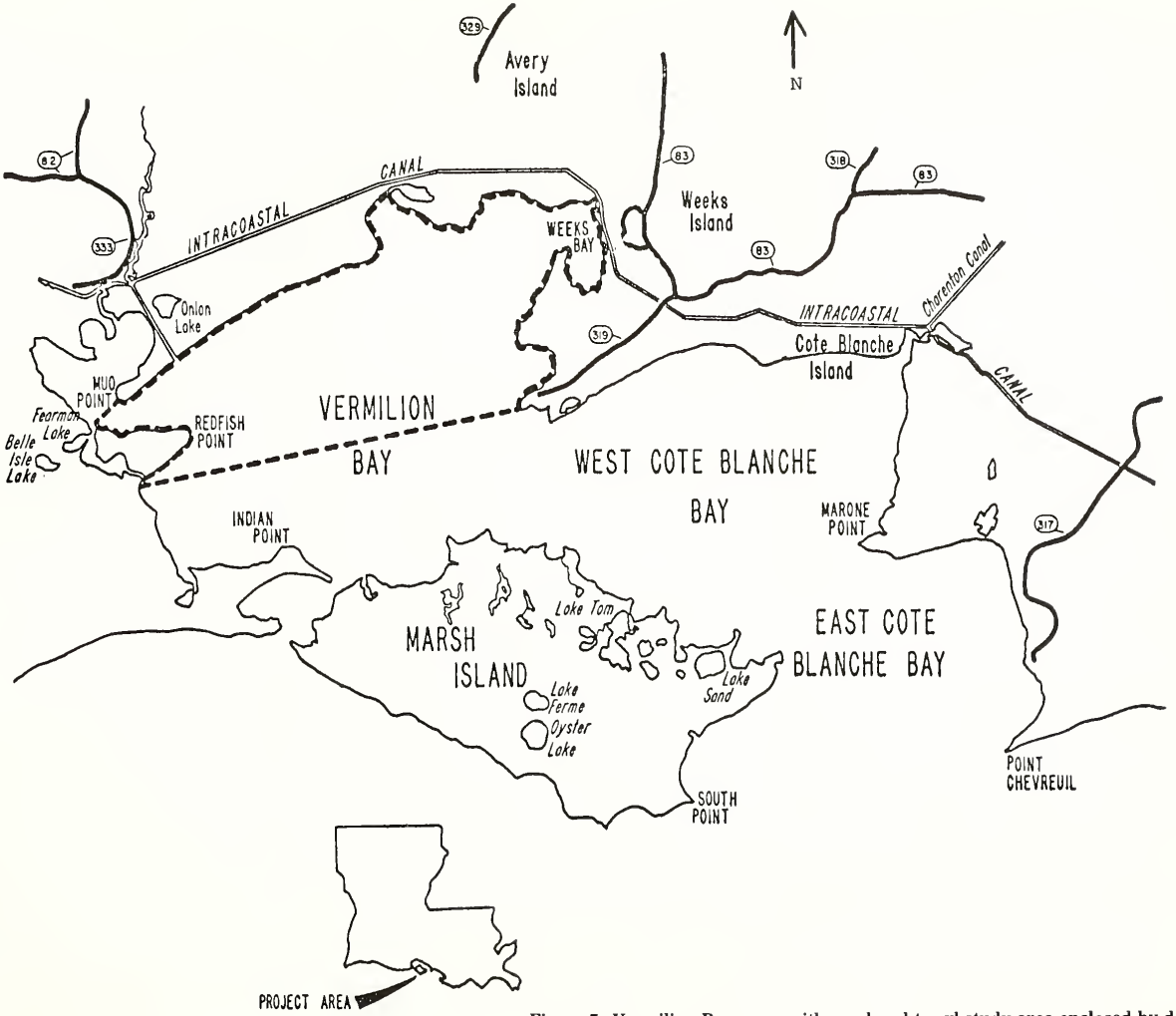

Figure 7. Vermilion Bay area, with creel and trawl study area enclosed by dotted line.

cause the average depth of Vermilion Bay and the Gulf of Mexico along that coastline is less than 10 feet.

The hydrological regime of Vermilion Bay is generally brackish, with salinities averaging less than 10 (parts per thousand) annually (Juneau and Barrett 1975). Salinities range from fresh (0.00 ppt to saline (near 30 ppt), depending on the season of year, amount of rainfall, prevailing wind, and other climatological conditions.

The study area consisted of that area north of a line drawn east-to-west across the middle of Vermilion Bay from Cypremort Point to Bayou Fearman and north to Mud Point, the northern bay shore of Vermilion Bay eastward, including Weeks Bay. The boundary included Shark Bayou to the public beach and followed the bayshore around to Cypremort Point.

Time required for completion of instantaneous counts and interviews was considered in formulating the size and location of the study area.

MATERIALS AND METHODS

The roving clerk survey employed in this recreational shrimping and finfishing study consisted of making sample measurements of the rate at which shrimping and finfishing pressures were being generated. These measurements were made by a clerk who used a motor vessel to make an instantaneous count of boats in the sampling area while simultaneously conducting interviews with those shrimpers and finfishermen he had sufficient opportunity to approach. In contrast to the situation with the anglers, a complete census of the shrimpers was not always possible nor appropriate because of the nature of trawling and of the much larger number of shrimping vessels compared to fishing vessels. Because surveys of saltwater angling pressure were conducted simultaneously and because of shrimp pressure, an "either/or" situation seemed to prevail: if appreciable quantities of shrimp were available, the angling pressure would taper off sharply in favor of recreational shrimping. As stated previously, it is safe to assume that the saltwater anglers and recreational shrimpers are largely members of the same population.

The same survey design served both for the saltwater angling and for the recreational shrimping; the identical sampling days, work periods, and direction of clerk's circuit of the body of water (whether clockwise or counterclockwise) was devised by the Institute of Statistics, North Carolina State University.

The initial survey unit, exclusive of closed seasons for shrimping in inside waters (January to mid-May, late July through early August, and late December), was the full year, which was divided into 48 sampling periods of a non-constant length (roughly equivalent to a week), and, except for the closed seasons, the design is the same as the saltwater angling survey. The actual length of the sampling periods was determined by the necessity of matching four periods per calendar month, thereby eliminating the possibility of a sampling period that overlapped months. This in turn would facilitate analysis on a monthly basis, should need arise, to the extent that opening and closing of seasons would permit. Stratification within periods was based on kind of day, i.e., weekdays versus weekends. One weekday and one weekend day were sampled within each of the periods. Several pre-designated holidays throughout the year were treated as if they were weekend days. Only those activities conducted during daylight hours were sampled, and each sampling day was divided into two sements known as work periods. Adjustments for both latitude within the Central Time Zone and shifts back and forth between Daylight Savings Time were included in the sampling design. The morning (AM) work period extended from adjusted sunrise until the midpoint between adjusted sunrise and adjusted sunset. Only one work period was used per sampling day, and a probability of 0.67 was assigned for expansion of AM workperiods into entire shrimping days, versus a probability of 0.33 for expansion of the PM work periods into entire shrimping days.

Data collected during the roving clerk recreational shrimping survey included instantaneous counts of shrimpers sighted and observations made during the personal interviews. The data included:

- sampling period
- kind of day
- sample number
- date
- interview code number
- hours spent trawling by vessel
- description of shrimping gear employed
- disposition of catch
- both number and estimated pounds for the following species:
  - white shrimp
  - brown shrimp
  - seabob
  - other miscellaneous species of shrimp

Data collected during the roving clerk saltwater angling creel survey were composed of instantaneous counts of anglers sighted and observations made during the personal interviews conducted, which included the following information:

- sampling period
- kind of day
- sample number
- date
- interview code number
- number of anglers in party
- hours spent angling by party
- angling gear employed
- type of bait used
- both number and estimated pounds for the following species:

- spotted seatrout (SPECS)
- sand seatrout (SDTRT)
- Atlantic croaker (CRKR)
- black drum (DRUM)
- flounder (FLD)
- gafftopsail catfish (GFTP)
- sheepshead (SPSH)
- sea catfish (SCT)
- other miscellaneous species (OTH)

DESCRIPTION OF SPECIES

In order to become better oriented with the species listed, a basic description of each follows. Locations most frequently fished or trawled are shown in Figures 8 and 9. This, however, does not mean that each particular species occurs in large numbers at any time in these locations. Many species are seasonal and are adversely affected by many factors that may cause populations to temporarily diminsh. Some of these factors include climatological and hydrological conditions.

The spotted seatrout *(Cynoscion nebulosus)* is a slender-bodied fish with small scales and a dorsal fin separated into two parts. Its body coloration is grayish silver to bluish above, shading to a silvery white below. Small black spots cover the upper regions of the body as well as the dorsal and caudal fins. The fish has a protruding lower jaw, and near the tip of the upper jaw are two long, pointed teeth or canines. The fish spawns within the coastal bays from about March through about October (Perret et al. 1980). The larvae and junveiles develop within estuaries, which provide protection and an adequate food supply (Pearson 1929, Miles 1950, Reid 1954, Moody 1950, Guest and Gunter 1958, Springer and Woodburn 1960). This species is highly sought by both sport and commerical fishermen.

The sand seatrout *(Cynoscion arenarius)* is similar in appearance to the spotted seatrout. Its body coloration, however, is pale, yellowish, unmarked above, and silvery or white below. The adults spawn in deeper channels of the bays or in the shallow Gulf (Hoese and Moore 1977). After hatching, the young fish make their way into the bays and estuaries where they find an adequate supply of food and protection from predators and grow rapidly. As winter approaches, they migrate into the deeper waters of the Gulf as adults.

The black drum *(Pogonias cromis)* is a relatively short, thick-bodied fish with a high, arched back. The lower jaw has numerous long barbels, and the throat is lined with many large flat teeth. Its body coloration ranges from silvery to brassy. Young fish have several dark vertical bands on their sides, but these disappear as the drum reaches maturity. Drum spawn during the late winter and spring in the Gulf of Mexico. Young drum spend a period of early development within the estuaries and then move gulfward (Gowanlock 1933). The black drum is not highly regarded for its edibility by either sport or commercial fishermen in Louisiana. It does, however, have excellent fighting qualities, which makes it attractive to recreational anglers.

The gafftopsail catfish *(Bagre marinus)* has long, flattened filaments that extend from its pectoral and dorsal spines. Its maxillary barbels are extended into long flattened filaments. Spawning takes place during the summer. After the eggs are fertilized, the males carry the eggs in their mouths until they hatch (Breder 1948). The young are brooded in the males' mouths for an additional two to four weeks. During this entire period, the males will not feed.

The sea catfish *(Arius felis)* has a long body that tapers to a slender tail and, unlike the gafftopsial catfish, the sea catfish has no long filaments. This fish was observed in higher salinities than the gafftopsail, although the young are common in the brackish bays. Young sea catfish (commonly referred to as "hard heads") feed on a diversity of items and have been known to graze the sides of other fishes (Hoese and Moore 1977). Sea catfish are considered pests by many fishermen.

The Atlantic croaker *(Micropogon undulatus)* has a rather elongated body and a long snout. Several short barbels are located on its lower jaw. Body coloration is silvery gray in young and yellowish with a pattern of narrow wavy bars composed of small spots in older fish (Hoese and Moore 1977). The body coloration may become a distinct bronze or yellow during the spawning season. The croaker is sought after by both commercial and sport fishermen.

The red drum *(Sciaenops ocellata)* has an elongated body, and the lower jaw has no barbels. The body coloration varies from a bronze to a copper color, with a black spot (occasionally several) at the base of the tail. The young have numerous larger black blotches. The adult red drum spawns near the tidal passes and in the shallow waters of the Gulf of Mexico from late summer through the fall (Perret et al. 1980 and Matlock, 1980). The young fish migrate from these spawning grounds into the nearby estuaries where they grow and develop into adults. The red drum is highly sought after by both sport and commericial fishermen in Louisiana.

The sheepshead *(Archosargus probatocephalus)* occurs from Texas northward to Cape Cod and above (Breder 1948). This species generally spawns in early spring in the Gulf of Mexico, and eggs hatch in about 40 hours at a temperature of 77°F (Breder 1948). Sheepshead are most often taken around pilings and piers but are also quite common around shell reefs.

In listing species of finfish and shrimps on individual interview sheets, most common and/or highly sought after species were included. It became necessary, however, to include a category within which "other" species could be tabulated. The "other" category most often was comprised of blue catfish *Ictalurus furcatus)* or alligator garfish *(Lepisosteus spatula)*.

The white shrimp *(Penaeus setiferus)* is one of the

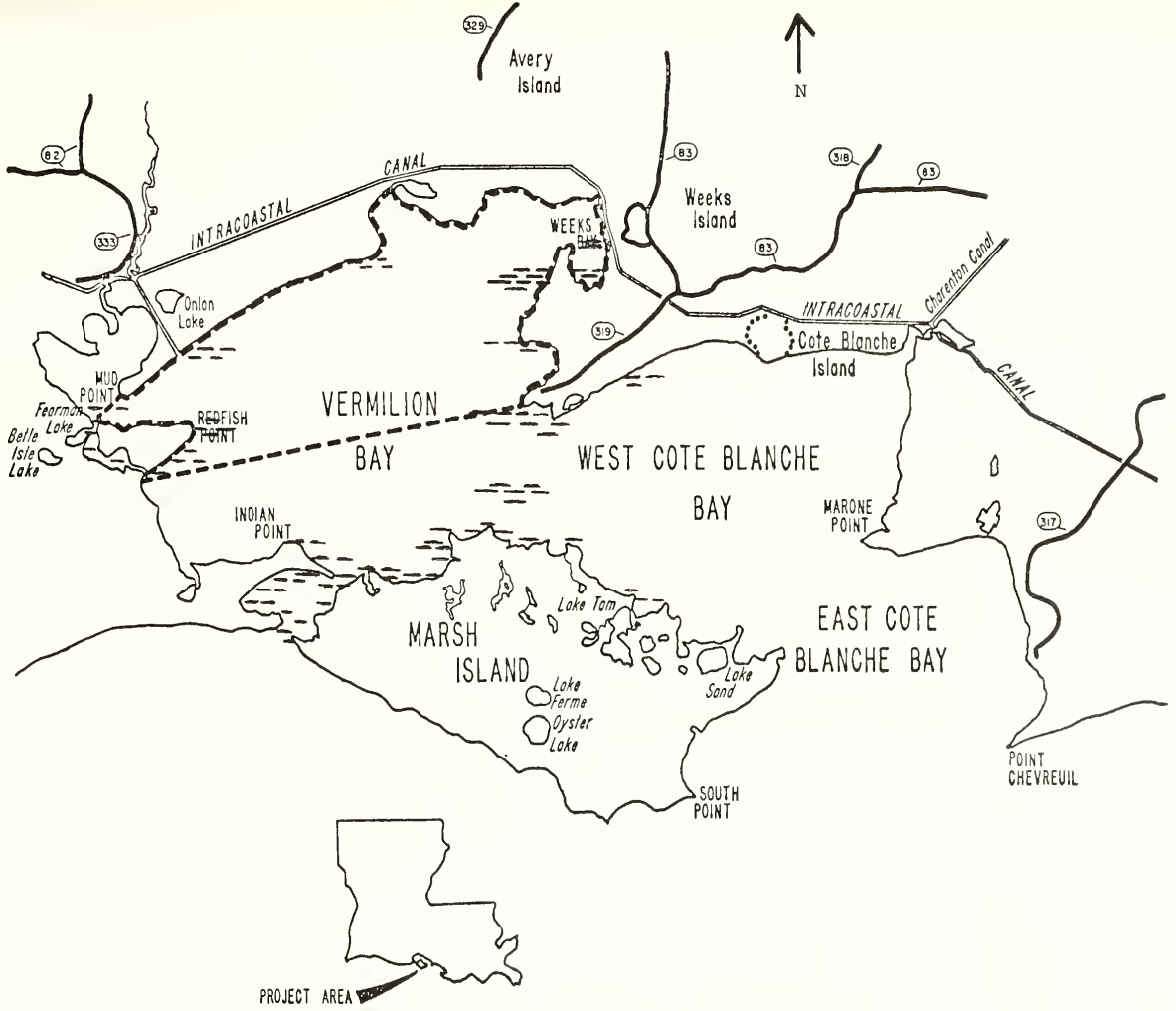

Figure 8. Areas within and around the study area that have been most commonly frequented by local finfishermen are shown by intermittent lines.

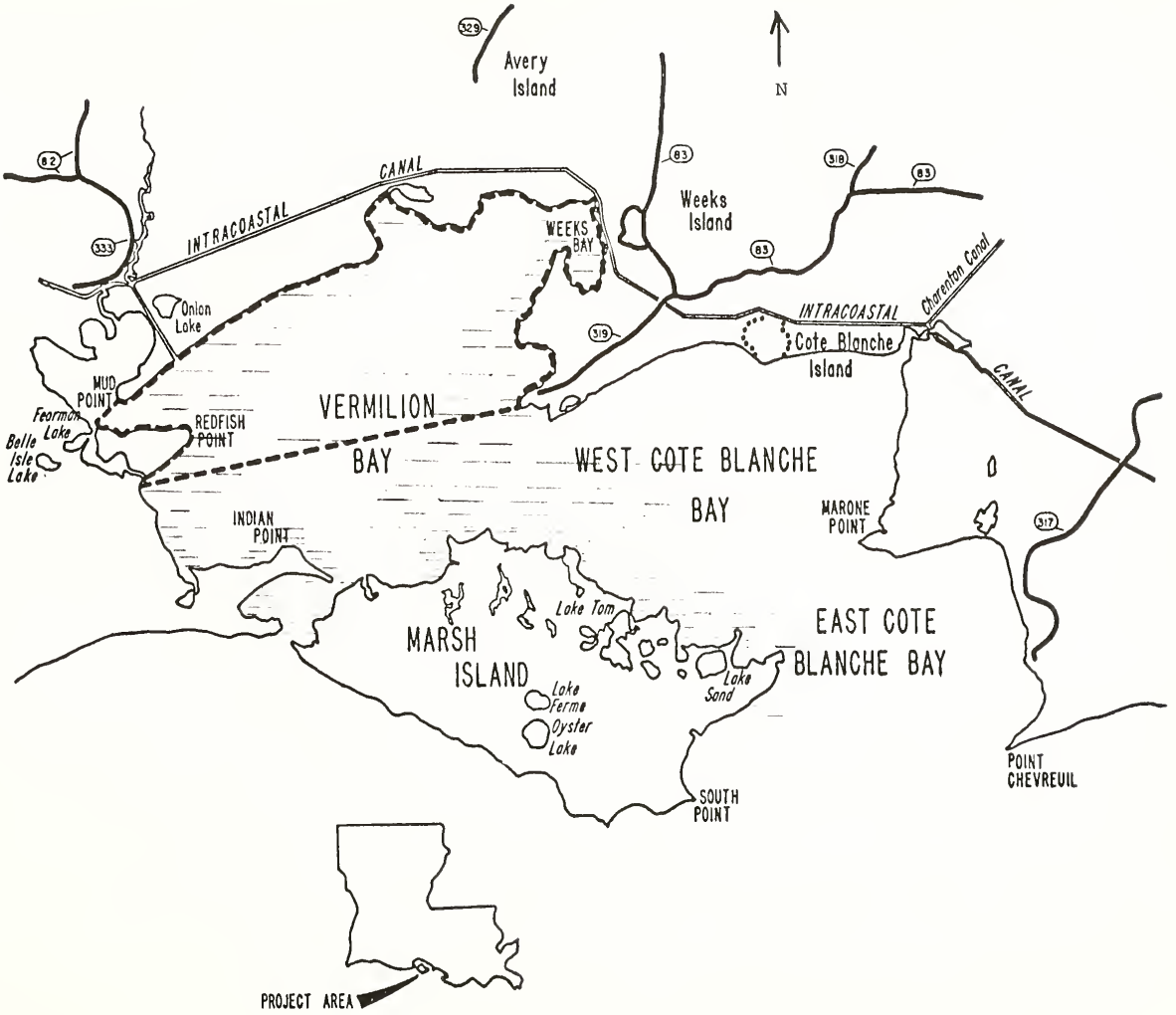

Figure 9. Areas within and around the study area most commonly frequented by local sport and commercial shrimpers are shown by intermittent lines.

two major species of shrimp taken from Louisiana bays and estuaries. The adult of the species can readily be distinguished from the brown shrimp *(Penaeus aztecus),* caught in our estuaries and bays; the white shrimp does not have a groove along each side of the rostrum and carina. White shrimp spawn in offshore waters of the Gulf of Mexico from March to September or October (Williams 1965). After hatching, the larvae undergo several molts before reaching the post-larval stage. From June to October, post-larvae, aided by the ideal currents, move into the Louisiana estuaries, where they grow and develop into adult shrimp (Perret et al. 1971). The adults move from the estuaries into deeper waters offshore during cooler winter temperatures.

The brown shrimp is characterized by a continuous, rounded groove that runs along both sides of the carina and the rostrum. Post-larval brown shrimp move into the estuaries of Louisiana between February and May, where they grow and develop into juvenile shrimp (St. Amant, Broom, and Ford 1965). The juvenile shrimp migrate offshore in two stages during the spring and summer: first, from the marshes to the open bays, and later, from the open bays into the Gulf of Mexico, where they mature and spawn. Both white and brown shrimp are sought after by recreational and commercial shrimpers.

RESULTS

As noted in the Materials and Methods portion of this report, surveys of saltwater angling and shrimping were conducted simultaneously. The experimental design was arranged, and instantaneous count forms and interview forms were designed to facilitate simultaneity. In reporting, however, the data must be presented separately, and calculations must be presented somewhat differently. Consequently, the results have been arranged in two sections: the Saltwater Angling section, and the Shrimp Trawling section.

Saltwater Angling

Field interviews used in conducting saltwater angling surveys included general information such as date, time, number of anglers, and time fished. These interviews also included numbers and pounds caught for each species and type of gear and bait used. Fishermen were asked whether they were fishing commercially or for sport. They were also asked whether angling was their primary activity or a sideline to some other primary activity of the day (such as shrimping or crabbing).

Instantaneous count was obtained by counting all individuals actually in the process of angling or attempting in any fashion to capture finfish.

Total effort, catch per hour, and harvest were derived by formulas and equations taken from the roving clerk program calculations at the Southeastern Wildlife Statistics Workshop in 1976, sponsored by the Southeast Game and Fish Commission. Total effort was derived by the following:

$$E = \frac{A \cdot D \cdot H}{P}$$

where E = total man-hours of fishing effort
A = instantaneous count of fishermen
D = number of calendar days in stratum
H = number of hours associated with instantaneous count
P = probability of sample selection

Success (catch per hour) was calculated from the following:

$$S = C/h$$

where S = catch of a species per hour of fishing
C = catch of a species from interviews
h = total hours of fishing from overall interviews (number of persons x hours fished)

Harvest was calculated by the following:

$$Y = E \cdot S$$

where Y = estimated total harvest of a species
E = total effort estimated for the stratum
S = success estimated for the stratum

Prior to the beginning of this study, legislation was proposed in Louisiana to regulate methods of harvesting certain saltwater finfish. Soon after beginning this project, the Louisiana legislature passed a bill that prohibited the use of monofilament gill nets. Until that time, monofilament gill nets were considered by commercial fishermen to be the most efficient method of taking spotted seatrout and red drum in Louisiana. Whether this legislation had an effect on the frequency of commercial finfishermen within the study area cannot be documented here. While conducting interviews for this study, we encountered a very small percentage of commercial net finfishermen. In addition, the commercial finfishermen interviewed during the first year of the study took only six of the species listed on the interview sheet and accounted for only 2.0 percent of the total calculated effort. During the second year of the study, only two commercial finfishermen were encountered. Neither had species of fish listed on the interview sheet except "other" species.

It should be noted that prior to the legislation further regulating this fishery and during the period from 1972 to 1978 when weekly monitoring programs were being conducted, very few gill nets or trammel nets were seen within or around the study area. Additionally, those encountered using gill or trammel nets generally fished large mesh nylon webbing during the winter months for alligator gar.

Figures 10, 11, 12, and 13 present calculated effort for recreational and commercial finfishermen encountered within the study area. These graphs denote effort by period and by month, as provided by the experimental design. Figure 14 shows total effort by each group for the entire two-year period.

Tables 1 and 2 (Appendix) give calculated statistics for commercial harvest, effort, and catch per

Figure 10. Calculated recreational effort (man-hours), by period, within the study area for the two-year study period.

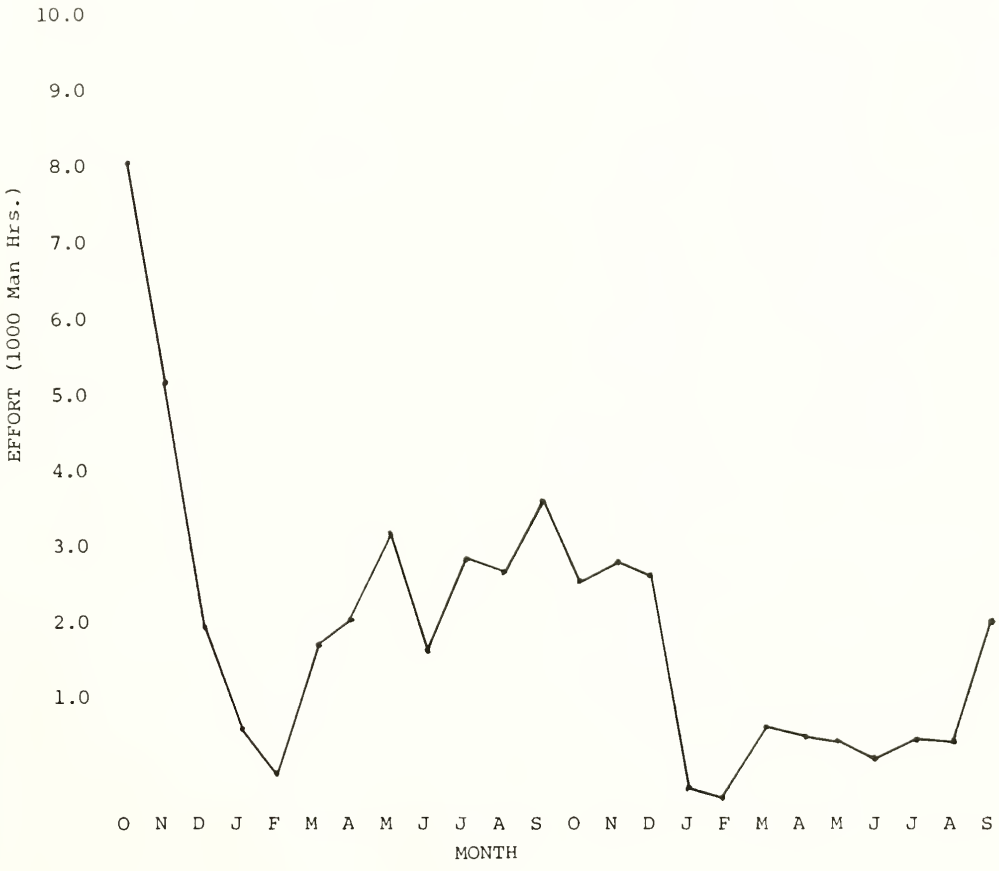

Figure 11. Calculated recreational effort (man-hours), by month, within the study area during the two-year study period.

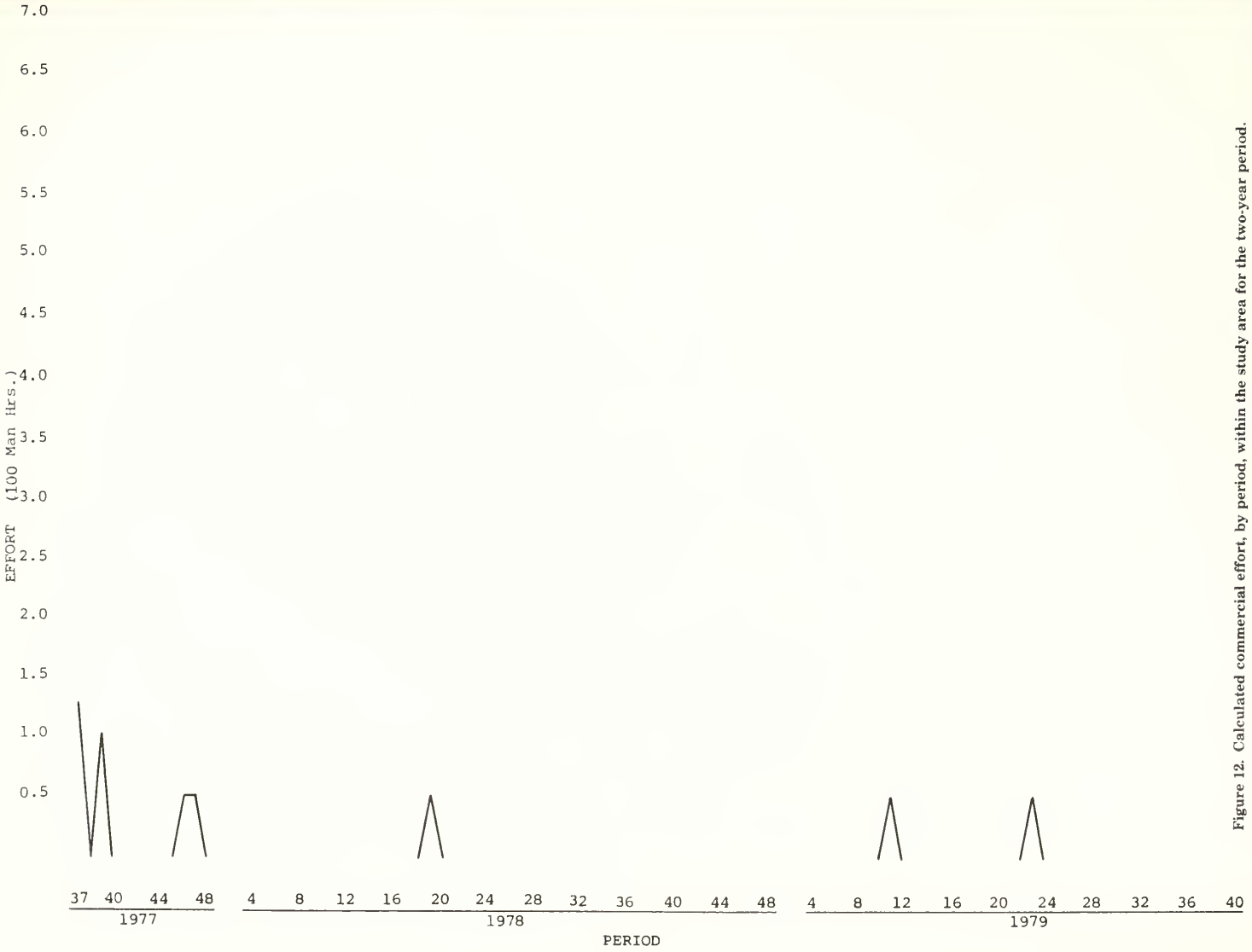

Figure 12. Calculated commercial effort, by period, within the study area for the two-year period.

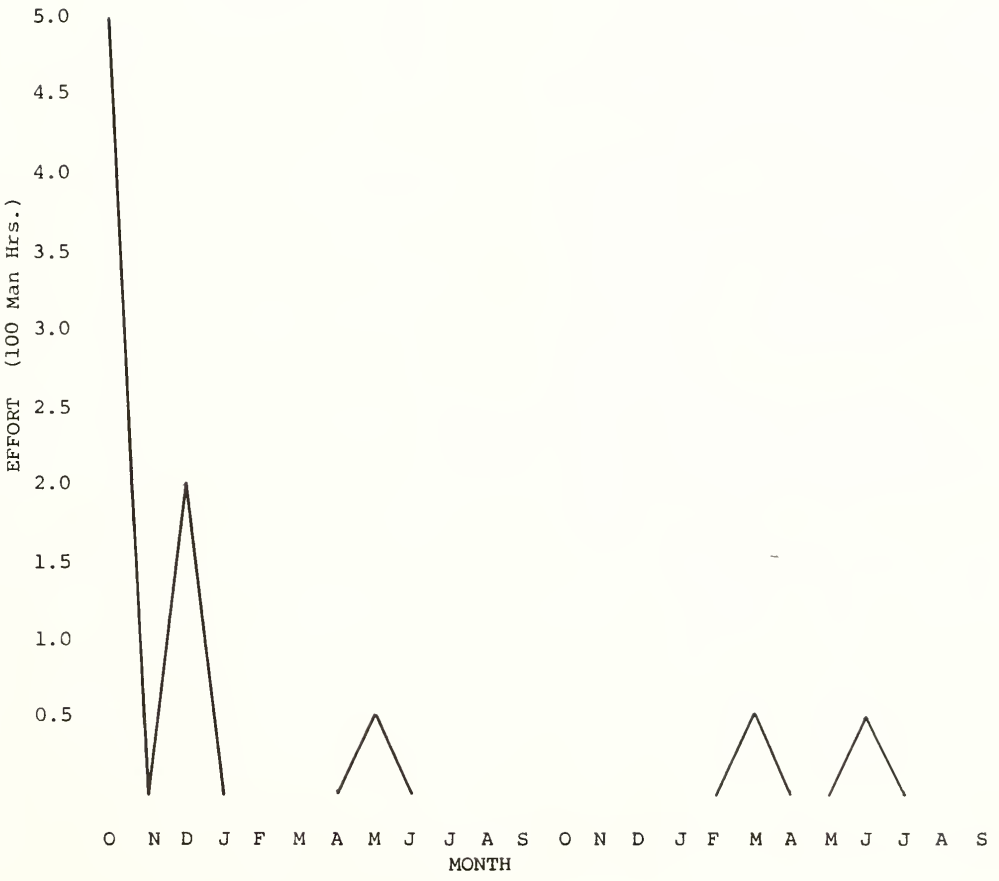

Figure 13. Calculated commercial effort, by month, within the study area for the two-year study period.

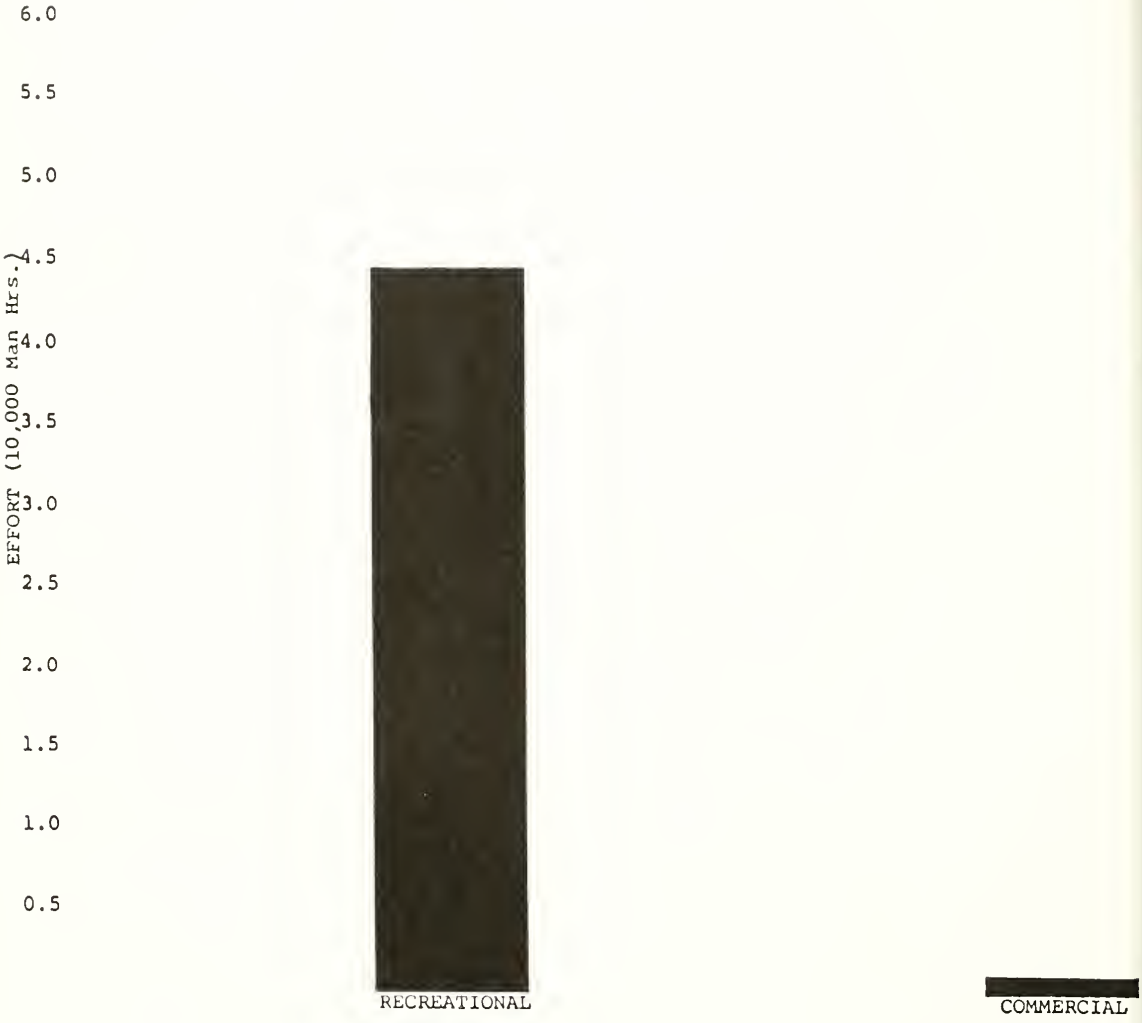

Figure 14. Total calculated effort by recreational and commercial finfishermen within the study area for the two-year study period.

effort by period and by month, as provided in the experimental design. These statistics show that commercial finfishermen took fish during only two months in 1977, one month in 1978, and two months in 1979. The most common species taken commercially were listed as "other," with a total harvest over the two-year study period of 801 individual fish (Figure 16). Recreational harvest for the same period was 938 (Figure 15). Commercial harvest for black drum within the two-year study was 50 (Figure 16). Recreational harvest for the same time was 2,715 (Figure 15). A total of 15,106 Atlantic croaker were taken recreationally (Figure 15); only 11 were taken commercially (Figure 16). The only other species taken commercially was southern flounder, with a total harvest of only 5; 1,057 were taken by recreational fishermen (Figures 15 and 16).

All other species listed on the interview sheets were taken only by recreational anglers. For the two-year study period, a total recreational harvest of 27,008 spotted seatrout was calculated; also, 779 sand seatrout, 15,106 Atlantic croaker, 5,340 sea catfish, and 897 gafftopsail catfish (Figure 15) were taken. Tables 3 and 4 list total recreational effort and harvest by species by period and month, respectively.

Commercial finfishermen had an estimated harvest within the study area of 978 fish for the two-year period. Recreational finfishermen for the same two-year period and within the same area had a total harvest calculated to be 56,405 individuals. Commercial catch of all fish per hour was 0.9; recreational catch per hour was 1.2. Fishes harvested commercially had an average individual weight of 3.2 pounds. Fishes taken recreationally had an average individual weight of 1.3 pounds.

Bowman, Adkins, and Tarver (1977) reported that of 145 fishermen contacted in Vermilion Parish having commercial fish net licenses (gill, trammel, or saltwater seine), none were professional. Professional fishermen were defined in that report as individuals deriving 30 percent or more of their annual income from fishing. All of the 145 net fishermen were casual fishermen owning gill nets and saltwater seines averaging 151 feet in length. Casual fishermen, of course, derive less than 30 percent of their annual income from fishing. This category would include weekend or vacationing fishermen who buy a license and use the net occasionally. Of 46 fishermen interviewed in Iberia Parish in that report only one was professional. Casual fishermen in Vermilion Parish took an average of 34.5 pounds of spotted seatrout during May 1976, while those in Iberia averaged 152.6 pounds. The one professional fishermen interviewed in Iberia Parish, in that report, recorded 120 pounds of spotted seatrout in May 1976 (Bowman, Adkins, and Tarver 1977).

Pesson (1974) interviewed coastal fishermen in Louisiana and found that the majority of commercial finfishermen (74 percent) fished hook and line (trotline) for catfish. Only 19 percent fished gill nets and only 6 percent fished monofilament gill nets.

Louisiana Department of Wildlife and Fisheries records showed that a total of 382 saltwater gill net licenses were sold statewide in 1978. In addition, a total of 256 saltwater fish trammel net, 341 saltwater fish seine, 118 saltwater fishing vessel, 29 commercial angler (rod and reel), and 1,944 commercial fishermen-retail bait seller licenses were issued. Only one non-resident saltwater fish vessel license was issued in Louisiana in 1978.

Shrimp Trawling

Field surveys for saltwater shrimping included such categories as date, time, trawl size, and length of time trawled. These interviews also requested data on total catch of each species of shrimp, license type, catch disposition, primary activity, and if sold, where.

Instantaneous counts were made by counting the number of boats actually in the process of trawling. Total effort, catch per hour, and harvest were derived by slightly modified formulas and equations taken from the roving clerk program calculations at the Southeastern Game and Fish Statistics Workshop in 1976. Total effort was derived by the following:

$$E = \frac{A \cdot D \cdot H}{P}$$

where E = total boat hours of fishing effort
A = instantaneous count of boats trawling
D = total calendar days in stratum
H = total hours associated with instantaneous count
P = probability of sample selection

Success was calculated from the following:

$$S = C/h$$

where S = catch of a species per hour of trawling
C = catch of a species from overall interviews in the sample
h = total hours of trawling (from interviews)

Harvest was calculated by the following:

$$Y = E \cdot S$$

where Y = estimated total harvest of a species
E = total effort estimated for the stratum
S = success estimated for the stratum

Calculated effort and harvest for white and brown shrimp and recreational and commercial shrimpers for each sampling period and month are listed in Tables 5 and 6, respectively (Appendix). Projected commercial effort (total trawling hours) for the entire two-year study period was 34,800 hours, as compared to 44,127 hours recreational effort for the same period (Figure 17). Estimated commercial harvest for the two-year period was 597,300 pounds of white shrimp and 208,900 pounds of brown shrimp (Figure

Figure 15. Total calculated recreational harvest for each species within the study area for the two-year study period.

Figure 16. Total calculated commercial harvest for each species within the the study area for the two-year study period.

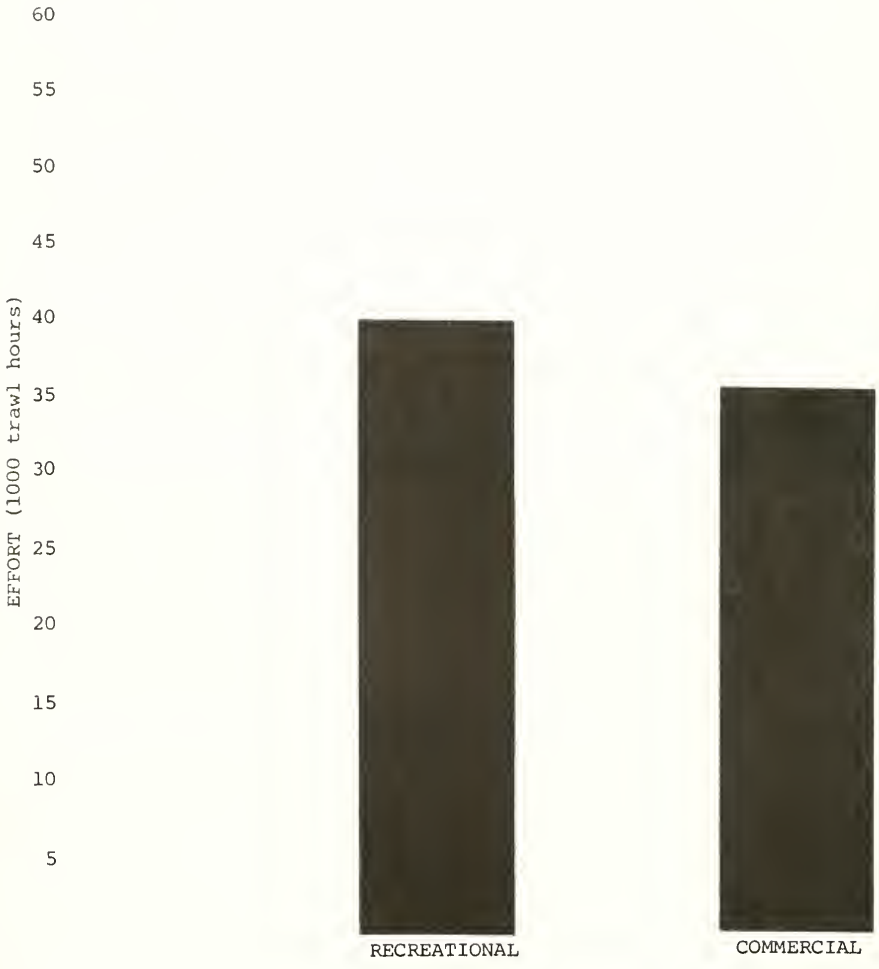

Figure 17. Total calculated recreational and commercial shrimping effort within the study area for the two year study period.

18). Estimated recreational harvest for the two-year period was 463,700 pounds of white shrimp and 178,900 pounds of brown shrimp (Figure 18). Commercial catch per effort (catch per hour of trawling) was 17.2 pounds for white shrimp and 6.0 pounds for brown shrimp. Recreational catch per effort (catch per hour of trawling) was calculated to 10.5 pounds of white shrimp and 4.1 pounds of brown shrimp. Average count per pound (heads on) of white shrimp for the two-year period was 56.2 for commercial and 43.4 for recreational (Figure 19). Average count per pound (heads on) of brown shrimp for the two-year period was 162.9 for commercial and 169.9 for recreational (Figure 19).

Data concerning gear (trawl) sizes revealed that, contrary to expectations, the 16-foot trawl was not the most popular or common gear size. In an Alabama study, the 16-foot trawl accounted for 30 percent of all the shrimp trawls registered in Mobile and Baldwin Counties (Swingle, Bland, and Tatum 1976). A similar proportion was expected in Louisiana; however, data in the Vermilion Bay area showed that the 16-foot trawl was used by only 4 percent of the recreational shrimpers. The most popular trawl size found among recreational shrimpers was 35 feet, which accounted for 24 percent of all sport shrimpers interviewed. Other common sizes were 40 feet (22 percent), 30 feet (19 percent), and 25 feet (9 percent).

The most common trawl sizes used by commercial fishermen were 50 feet (31 percent), 40 feet (20 percent), and 48 feet (13 percent), as listed in Table 7.

Louisiana Department of Wildlife and Fisheries records indicated that a total of 14,830 saltwater shrimp trawl and vessel licenses were sold in Louisiana in 1978, with 589 sold in Iberia Parish and 470 sold in Vermilion Parish. This license allows shrimpers to use a trawl (as registered on license) larger than 16 feet in length to catch as much shrimp as desired and to offer them for sale. Almost 90 percent of these licenses were issued for single trawls. A similar license allows a trawl larger than 16 feet and permits catches as much as desired but does not legally allow the sale of these shrimp. A total of 10,875 of these licenses were sold statewide in 1978, with 572 being sold in Iberia Parish and 702 in Vermilion Parish. A total of 99 percent of these licenses were sold for single trawls. In addition, another non-commercial license may be sold that would allow an individual to sell his catch. A total of only 228 (2 percent of all "non-commercial licenses was sold statewide in 1978).

DISCUSSION

This study was designed to determine the relationship between commercial and recreational catches of finfish and shrimp and to determine what effect recreational catch has on the total resource. Commercial catch and landings figures have been available in a limited fashion for several years; however, recreational harvest figures have always been inadequate for proper management evaluations. Lorio and Perret (1980) stated that in Texas, restrictions were imposed on red drum harvest that included sociological, economic, and biological considerations but that failed to determine a maximum allowable catch. The Gulf of Mexico Fishery Management Council (1980) recognized a lack of basic data needed for management in the shrimping industry and cited in the objectives of its proposed management plan, a provision for a statistical reporting system.

As the need for recreational and commercial finfishing areas multiplied in recent years, because of an increase in effort by both groups, conflicts between the user groups became more apparent. Louisiana passed legislation in 1977 regulating certain commercial gears on finfishes and also setting creel limits for recreational fishermen on certain species. Waguespack (1976) reported a decline in spotted seatrout and red drum populations, and Dudenhefer (1977) reported that at least 90 percent of the edible finfish catch was taken by recreational fishermen. Hopkins and Petrocelli (1975) reported on similar legislation that restricted harvest without sound biological evidence supporting such legislation.

Harvest and management techniques play a major role in determining sizes of fishery populations, but environmental factors play an even greater role. Butler et al. (1971) and Childress (1971) proposed that high concentrations of DDT present in the ovaries of spotted seatrout were responsible for a decrease in spawning in Texas bays and estuaries and for subsequent decreased production of stock. They also implied that the presence of that pesticide reduced survival rates in young or juvenile fishes. Hopkins and Petrocelli (1975) reported that nutrients occurring along the Gulf of Mexico Coast from the Mississippi River also contain deadly poisons and pesticides that alter reproductive processes in many fishes and crustaceans.

Generally, the most influential overall factors affecting fishery populations along the Gulf of Mexico coast are natural ones such as water temperature, salinity, erosion, hurricanes, and freezes. Simmons and Breur (1962) reported that the natural hard freeze experienced along the coast about once every 10 years destroys more fish than have been harvested commercially for 50 years. In Louisiana, the flood of 1973 created problems in the fishing industry, and in Florida, Mississippi, Alabama, and Texas, outbreaks of "red tide" *(Gymnodium breve)* have also caused significant fish and shellfish kills.

All of these factors and many more dramatically affect the production and subsequent harvest of finfish and shrimp in the estuaries. Many of the factors are related; many are seasonal; and some are cyclic. For this reason, sound management programs are usually based on an average derived from many

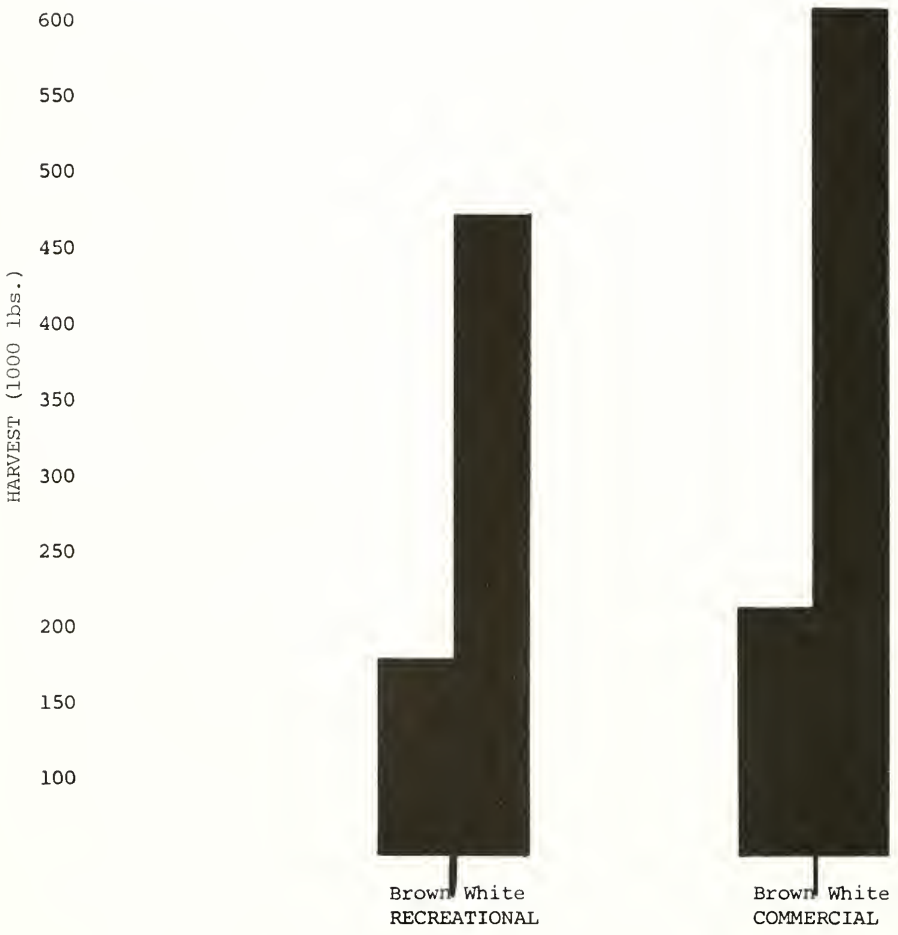

Figure 18. Total calculated recreational and commercial brown and white shrimp harvest within the study area for the two-year study period.

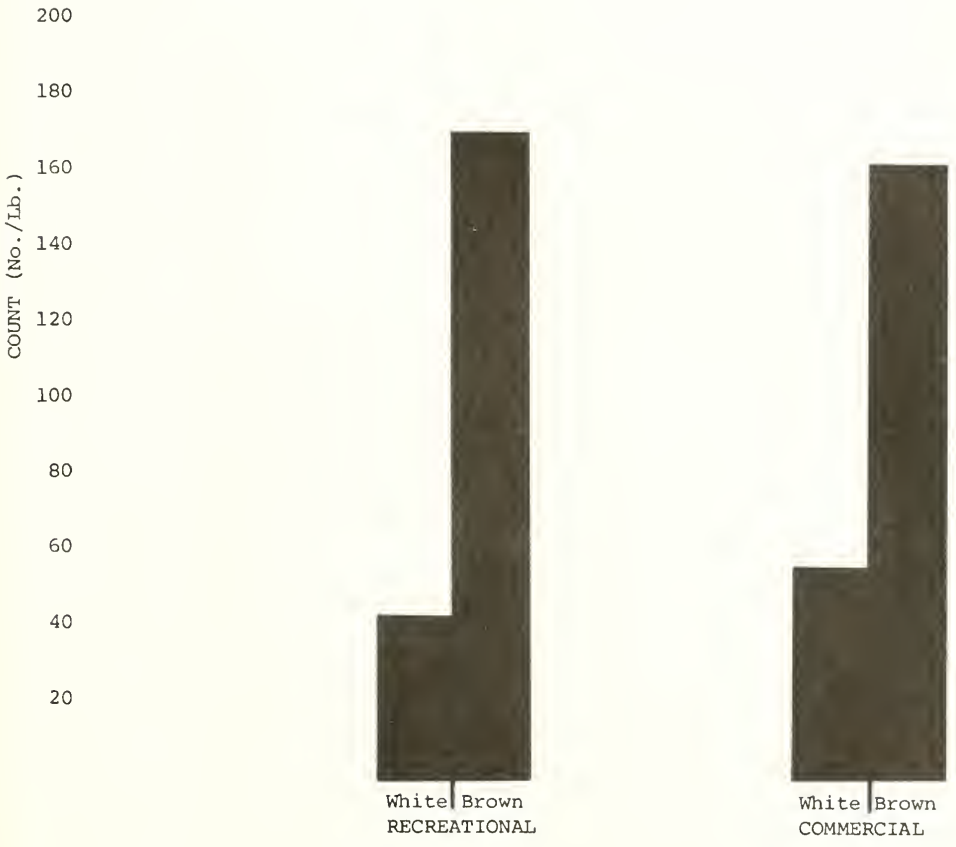

Figure 19. Average count per pound of brown and white shrimp taken from the interviews within the study area for the two-year period.

years of data. Louisiana his historically based its spring shrimp season on such data. Finfish management was only in its embryonic stages when legislation was enacted in 1977, and the importance of providing sound base data was emphasized at that time.

As is the case in any management practice, before a rational program can be devised, there must be a reasonable conceptualization of the industry. In the commercial shrimping industry, a fair impression of the commercial pressure was determined at the onset of management practice years ago; however, no true measure of the recreational component was ever established. In Louisiana, limited data have been available concerning recreational and commercial finfish statistics.

From the interviews and instantaneous counts in the Vermilion Bay study area, we determined that recreational finfishermen took about 98.3 percent of all fish harvested, as compared to 1.7 percent by commercial finfishermen. Commercial finfishermen took only six species of the ten listed on the interview sheet, recreational finfishermen took all ten. Calculated harvest derived from expansion of creel data showed that recreational finfishermen landed 95 percent of the red drum, 94 percent of the sheepshead, 98 percent of the black drum, 99 percent of the southern flounder, 99 percent of the Atlantic croaker, and 67 percent of the miscellaneous or "other" category. As previously reported, recreational finfishermen had a calculated harvest of 100 percent of all spotted seatrout, sand seatrout, sea catfish, and gafftopsail catfish.

Recreational shrimpers exerted 56 percent of the effort (trawl hours) commercial shrimpers exerted the remaining 44 percent. Commercial shrimpers harvested 56 percent of the white shrimp landed; recreational shrimpers landed 44 percent. Recreational shrimpers landed 46 percent of the brown shrimp harvested; commercial snrimpers landed 54 percent.

Finally, there is always suspicion that reported landings figures accounted for only a portion of total harvest of shrimp and finfish in Louisiana. A substantial amount of shrimp and fish were also considered to be sold for "cash" and unreported, and an even greater amount was caught or taken by recreational fishermen without any record whatsoever. This study, of course, documented that in the Vermilion Bay area recreational shrimpers took almost half of the shrimp harvested and almost all of the edible finfish.

Since management policies should be directed toward sustaining the resource, it would, therefore, seem most practical to regulate that portion of the harvest most influenced or, at least, to regulate according to influence. Policies would include regulations regarding pollution, habitat alteration, economics, fishing effort, management by seasonal occurrence and size and growth, gear efficiency, catch limits, and license fees. Regulations or management policies must guarantee a sustained harvest and yet be flexible enough to adjust to changing environmental conditions.

Although the percent of the recreational catch that enters the commercial market is unknown, it is obvious that these landings are used largely by residents in the Vermilion Bay area, thus reducing to some degree, sales of local fishery products.

As population density increases and as support habitat (in many cases) decreases, pressure on sustainable resources increases. Sound technical data upon which to base decisions is vital if the users are to continue to enjoy a viable resource from which to harvest. Although populations fluctuate, depending on hydrological and environmental factors, it is the resource managers' job to regulate the resource within these known levels of abundance. Since various users have different needs, it is necessary that the management scheme accommodate all users while insuring the viability of the resource.

MANAGEMENT RECOMMENDATIONS

Saltwater Angling

Fishery management in Louisiana is presently administered by the Department of Wildlife and Fisheries. Responsibilities of this department include scientific research relating to the development of sound management recommendations, education, law enforcement, research to increase production or efficiency, administration, licensing, and taxation. The Louisiana Legislature has jurisdiction over regulating finfish, and it may set laws concerning licenses, mesh size for nets, types of nets and vessels, and size limits of finfish taken commercially or recreationally. The Secretary of the Department of Wildlife and Fisheries, who is the executive officer and head administrator, has the authority, under certain conditions, to set policy regarding gear, seasons, and possession limits. The Secretary of the Department is appointed by the Governor with the consent of the Senate.

In Louisiana, fishing for saltwater finfish is licensed and governed under general regulations and not by species, with the exception of spotted seatrout and red drum. Controversies between commercial and recreational finfishermen in recent years resulted in the enactment of several laws specifically directed toward managing spotted seatrout and red drum. These laws include recreational catch limits of not more than a combined total of 50 spotted seatrout or red drum per day, with no more than a two-day catch in possession. Recreational size limits allow only two red drum at or in excess of 36 inches in length. Commercial finfishermen are limited to a minimum spotted seatrout size of ten inches and a minimum red drum size of 16 inches (both species measured with mouth closed). Another regulation

resulting from the recreational and commercial finfishermen controversy prohibits the use of monofilament gill nets or trammel nets south of the Gulf Intracoastal Waterway, in Lake Pontchartrain, Lake Maurepas, Calcasieu Lake, that portion of the Ship Channel adjoining Calcasieu Lake, and in Lake St. Catherine.

Perret (1981) listed several problems involving ing the management of saltwater finfish, particularly spotted seatrout and red drum, along the coast of the Gulf of Mexico. Those of particular importance included a lack of understanding of development of fisheries management systems and the administration of laws enacted without prior consideration of scientific evidence. Also extremely important were problems regarding habitat alteration and the occurrence of pesticides and other pollutants in the estuaries.

Data obtained from interviews and instantaneous counts in this study on Vermilion Bay indicate that recreational finfishermen comprise the major portion of the entire fishery. Recorded catch and landings figures do not always reflect that. Because data regarding catch and effort for both recreational and commercial finfishing activities have been inadequate, management practices based on these data may also be inadequate.

Management policies pertaining to saltwater finfish in Louisiana should have as their basis a complete record of sound scientific data, including the following:

- regular monitoring of environmental parameters, including hydrology, climatology, etc.
- habitat changes
- index and regular monitoring of biological pollutants present within the ecosystem
- catch, effort, and catch per effort data of important finfish for both commercial and recreational finfishermen
- occurrence, distribution, migration, growth, mortality, etc., for each important species
- sociological and economical factors affecting the industry.

Sound management policies must also properly educate the resources users so that the reasons for particular management policies are fully understood. Finally, it is most important that each user group have an opportunity to contribute ideas and views toward making final decisions.

Shrimp Trawling

As previously mentioned in management recommendations for saltwater finfish, the administration of fishery management is under the authority of the Department of Wildlife and Fisheries. Basic responsibilities are essentially the same as those outlined previously for finfish. Many of the same problems are encountered, especially those mentioned by Perret et al. (1980) regarding a lack of understanding of development of management systems and those regarding habitat alteration and pollution.

Licensing in Louisiana allows shrimpers a variety of choices regarding gear size, catch, vessel size, etc. Additionally, shrimpers have the right under the present system to use a 16-foot otter trawl and to catch up to 100 pounds of shrimp per day without having to purchase a shrimping license. This, of course, has always meant that a portion of the entry is operating without records concerning effort, catch, etc. In Louisiana, it was only generally assumed that most recreational shrimpers operated in such a manner. Recent theories suggest that recreational shrimpers now use larger and more efficient gear. This study in Vermilion Bay supports that theory and documents the infrequent use of 16-foot trawls in the study area. Because of the minimal costs of commercial licenses and the ease in which they may be obtained, it has become extremely difficult to separate commercial shrimpers from recreational shrimpers. in many cases the margin between the two groups overlaps, and "sport" shrimpers temporarily become commercial after making substantially large catches. In Louisiana, especially around Vermilion Bay, this is common.

Biological and environmental parameters in Louisiana have been monitored by the Department of Wildlife and Fisheries. The coastal marshes and estuaries have been divided into seven study areas, each having a complete team of research and management-oriented personnel. Using the vast amount of scientific information collected over the years in these areas, Gaidry and White (1973) formulated recommendations for managing Louisiana's shrimp resources. These recommendations were followed with considerable success. Other factors, however, have recently caused problems within the shrimping industry. In recent years, the "softening" economy began to play an increasingly important role in the industry. Even more recently, increased entry has become a threat to the livelihood of local shrimpers. The closure of Mexican waters to United States fishermen and the possible closure of Texas waters for certain time periods could force an enormous entry into Louisiana waters.

Management recommendations, therefore, for shrimp resources in Louisiana should initially continue to rely on firm scientific data, including:

- regular monitoring of environmental parameters including hydrology, climatology, etc.
- occurrence, distribution, migration, growth, recruitment, mortality, etc., for each important shrimp species on a regular basis
- accurate catch and landings data for recreational, commercial, and "semi-commercial" shrimpers
- catch, effort, and catch per effort for both recreational and commercial shrimpers
- economic activities, including operating costs

and market fluctuations
- sociological compositions and factors affecting the industry.

Management practices in effect in Louisiana have proved successful. As expected, commercial landings have fluctuated, but the general trend has been upward; catches should remain relatively stable barring unforseen problems with the environment. Catch per effort, however, has decreased because of the large increase in the number of commercial shrimpers (46 percent) between 1976 and 1980 (Roberts, 1980, reported a direct effect on shrimp prices because of the slowdown in the economy), it would be extremely advisable to implement management plans that use data assimilated from the latest economic figures along with relevant biological and environmental information.

Finally, before management plans are implemented, it would be extremely useful to provide explanations of the plans so that each user group understands the expected benefits. Once that has been accomplished, each user group would recognize the value of the plans, and accept them as sound, useful practices.

Appendix

Table 1
Calculated Commercial Harvest, Effort, and Catch Per Effort By Species By Period Within the Study Area

Date	Period	No.	Lbs	Effort	C/E No.	C/E Lbs	Species
OCTOBER	1977						
1 - 8	37	670.5	2011.4	268.2	2.5	7.5	Other
9 - 15	38	7.1	29.8	34.0	0.2	0.9	Redfish
		14.2	155.9	34.0	0.4	4.6	Other
16 - 23	39	17.7	106.3	212.7	0.04	0.08	Sheepshead
23 - 31	40	—	—	0	—	—	
NOVEMBER	1977						
1 - 7	41	—	—	0	—	—	
8 - 15	42	—	—	0	—	—	
16 - 22	43	—	—	0	—	—	
23 - 30	44	—	—	0	—	—	
DECEMBER	1977						
1 - 8	45	—	—	0	—	—	
9 - 16	46	43.9	65.8	87.8	0.5	0.8	Sheepshead
17 - 23	47	9.1	18.3	109.7	0.08	0.2	Redfish
		11.4	57.1	109.7	0.1	0.5	Croaker
		4.6	4.6	109.7	0.04	0.04	Flounder
		22.9	6.9	109.7	0.2	0.06	Other
24 - 31	48	—	—	0	—	—	
JANUARY	1978						
1 - 8	1	—	—	0	—	—	
9 - 16	2	—	—	0	—	—	
17 - 24	3	—	—	0	—	—	
25 - 31	4	—	—	0	—	—	
FEBRUARY	1978						
1 - 7	5	—	—	0	—	—	
8 - 14	6	—	—	0	—	—	
15 - 21	7	—	—	0	—	—	
22 - 28	8	—	—	0	—	—	
MARCH	1978						
1 - 8	9	—	—	0	—	—	
9 - 17	10	—	—	0	—	—	
18 - 24	11	—	—	0	—	—	
25 - 31	12	—	—	0	—	—	
APRIL	1978						
1 - 8	13	—	—	0	—	—	
9 - 15	14	—	—	0	—	—	
16 - 22	15	—	—	0	—	—	
23 - 30	16	—	—	0	—	—	
MAY	1978						
1 - 7	17	—	—	0	—	—	
8 - 15	18	—	—	0	—	—	
16 - 23	19	25.1	50.1	125.4	0.2	0.4	Redfish
		50.1	250.7	125.4	0.4	2.0	Black Drum
		25.1	125.4	125.4	0.2	1.0	Other
24 - 31	20	—	—	0	—	—	

Table 1 (Continued)

Date	Period	No.	Lbs	Effort	C/E No.	C/E Lbs	Species
JUNE	1978						
1 - 7	21	—	—	0	—	—	
8 - 15	22	—	—	0	—	—	
16 - 23	23	—	—	0	—	—	
24 - 30	24	—	—	0	—	—	
JULY	1978						
1 - 7	25	—	—	0	—	—	
8 - 15	26	—	—	0	—	—	
16 - 23	31	—	—	0	—	—	
24 - 31	28	—	—	0	—	—	
AUGUST	1978						
1 - 8	29	—	—	0	—	—	
9 - 16	30	—	—	0	—	—	
17 - 24	31	—	—	0	—	—	
25 - 31	32	—	—	0	—	—	
SEPTEMBER	1978						
1 - 6	33	—	—	0	—	—	
7 - 14	34	—	—	0	—	—	
15 - 22	35	—	—	0	—	—	
23 - 30	36	—	—	0	—	—	
OCTOBER	1978						
1 - 8	37	—	—	0	—	—	
9 - 15	38	—	—	0	—	—	
16 - 23	39	—	—	0	—	—	
24 - 31	40	—	—	0	—	—	
NOVEMBER	1978						
1 - 8	41	—	—	0	—	—	
9 - 16	42	—	—	0	—	—	
17 - 23	43	—	—	0	—	—	
24 - 30	44	—	—	0	—	—	
DECEMBER	1978						
1 - 8	45	—	—	0	—	—	
9 - 16	46	—	—	0	—	—	
17 - 24	47	—	—	0	—	—	
25 - 31	48	—	—	0	—	—	
JANUARY	1979						
1 - 7	1	—	—	0	—	—	
8 - 15	2	—	—	0	—	—	
16 - 23	3	—	—	0	—	—	
24 - 31	4	—	—	0	—	—	
FEBRUARY	1979						
1 - 7	5	—	—	0	—	—	
8 - 15	6	—	—	0	—	—	
16 - 22	7	—	—	0	—	—	
23 - 28	8	—	—	0	—	—	
MARCH	1979						
1 - 8	9	—	—	0	—	—	
9 - 16	10	—	—	0	—	—	
17 - 24	11	16.1	67.2	107.5	0.2	0.6	Other
25 - 31	12	—	—	0	—	—	

Table 1 (Continued)

Date	Period	No.	Lbs.	Effort	C/E No.	C/E Lbs.	Species
APRIL	**1979**						
1 - 8	13	—	—	0	—	—	
9 - 15	14	—	—	0	—	—	
16 - 22	15	—	—	0	—	—	
23 - 30	16	—	—	0	—	—	
MAY	**1979**						
1 - 8	17	—	—	0	—	—	
9 - 16	18	—	—	0	—	—	
17 - 24	29	—	—	0	—	—	
25 - 31	20	—	—	0	—	—	
JUNE	**1979**						
1 - 8	21	—	—	0	—	—	
9 - 16	22	51.6	193.4	96.7	0.5	2.0	Other
17 - 23	23	—	—	0	—	—	
24 - 30	24	—	—	0	—	—	
JULY	**1979**						
1 - 7	25	—	—	0	—	—	
8 - 15	26	—	—	0	—	—	
16 - 23	27	—	—	0	—	—	
24 - 31	28	—	—	0	—	—	
AUGUST	**1979**						
1 - 8	29	—	—	0	—	—	
9 - 15	30	—	—	0	—	—	
16 - 23	31	—	—	0	—	—	
24 - 31	32	—	—	0	—	—	
SEPTEMBER	**1979**						
1 - 7	33	—	—	0	—	—	
8 - 14	34	—	—	0	—	—	
15 - 22	35	—	—	0	—	—	
23 - 30	36	—	—	0	—	—	

Table 2
Calculated Commercial Harvest, Effort, and Catch Per Effort By Species By Month Within the Study Area

Month	No.	Lbs.	Effort	C/E No.	C/E Lbs	Species
1977						
Oct.	24.8	136.1	514.9	0.05	0.26	Redfish
	8.9	17.7	514.9	0.02	0.03	Sheepshead
	684.7	2167.3	514.9	1.33	4.21	Other
	718.4	2321.1	514.9	1.40	4.51	All
Nov.	—	—	0	—	—	
Dec.	9.1	18.3	197.5	0.05	0.09	Redfish
	43.9	65.8	197.5	0.22	0.33	Sheepshead
	11.4	57.1	197.5	0.06	0.29	Croaker
	4.6	4.6	197.5	0.02	0.02	Flounder
	22.9	6.9	197.5	0.12	0.03	Other
	91.9	152.7	197.5	0.47	0.77	All
1978						
Jan.	—	—	0	—	—	
Feb.	—	—	0	—	—	
Mar.	—	—	0	—	—	
Apr.	—	—	0	—	—	
May	25.1	50.1	125.4	0.20	0.4	Redfish
	50.1	250.7	125.4	0.40	2.0	Black Drum
	25.1	125.4	125.4	0.20	1.0	Other
	100.3	426.2	125.4	0.80	3.40	All
June	—	—	0	—	—	
July	—	—	0	—	—	
Aug.	—	—	0	—	—	
Sept.	—	—	0	—	—	
Oct.	—	—	0	—	—	
Nov.	—	—	0	—	—	
Dec.	—	—	0	—	—	
1979						
Jan.	—	—	0	—	—	
Feb.	—	—	0	—	—	
Mar.	16.1	67.2	107.5	0.2	0.6	Other
Apr.	—	—	0	—	—	
May	—	—	0	—	—	
June	51.6	193.4	96.7	0.5	2.0	Other
July	—	—	0	—	—	
Aug.	—	—	0	—	—	
Sept.	—	—	0	—	—	

Table 3.
Total Recreational Effort and Harvest By Species, By Period

Date	Period	Effort (Man-Hrs.)	No. Specs	No. Sdtrt	No. Crkrs	No. Rdfs	No. Drum	No. Fld	No. Spsh	No. Sct	No. Gftp	No. Oth
OCTOBER	1977											
1-8	37	1,522.2	0	47	439	0	0	0	0	47	281	175
9-15	38	769.5	56	0	16	36	36	0	56	16	0	147
16-23	39	3,402.0	1,500	0	74	0	246	183	0	74	0	183
24-31	40	2,458.5	4.111	0	166	153	95	0	19	0	0	19
NOVEMBER	1977											
1-7	41	333.9	15	0	22	15	0	7	0	0	0	0
8-15	42	93.6	0	0	0	0	0	0	0	0	0	0
16-22	43	1,109.3	1,960	0	0	0	0	0	0	0	0	0
23-30	44	3,750.0	4,594	0	36	59	220	0	140	80	0	0
DECEMBER	1977											
1-8	45	1,125.0	454	80	216	54	0	160	0	27	0	0
9-16	46	661.5	134	0	0	0	0	0	0	0	0	0
17-23	47	272.0	13	0	0	0	0	0	0	0	0	0
24-31	48	132.3	171	0	0	0	0	0	0	0	0	0
JANUARY	1977											
1-8	1	810.0	1,249	0	0	0	0	0	0	0	0	0
9-16	2	0	—	—	—	—	—	—	—	—	—	—
17-24	3	0	—	—	—	—	—	—	—	—	—	—
25-31	4	0	—	—	—	—	—	—	—	—	—	—
FEBRUARY	1978											
1-7	5	0	—	—	—	—	—	—	—	—	—	—
8-14	6	16.2	0	0	0	0	0	0	0	0	0	0
15-21	7	231.0	0	0	0	0	0	0	100	0	0	0
22-28	8	0	—	—	—	—	—	—	—	—	—	—
MARCH	1978											
1-8	9	0	—	—	—	—	—	—	—	—	—	—
9-17	10	814.2	0	0	54	0	107	0	54	0	0	0
18-24	11	915.0	0	0	167	0	165	100	34	100	0	100
25-31	12	223.2	0	0	0	0	0	0	0	83	0	167
APRIL	1978											
1-8	13	0	—	—	—	—	—	—	—	—	—	—
9-15	14	682.5	70	0	175	0	93	12	0	12	0	0
16-22	15	1,287.0	0	0	333	0	371	0	111	660	0	0
23-31	16	766.8	0	22	172	10	54	11	11	196	54	0
MAY	1978											
1-7	17	530.4	0	0	338	0	0	0	49	49	0	0
8-15	18	0	0	0	0	0	0	0	0	0	0	0
16-23	19	2,184.0	0	0	1,710	109	219	19	0	460	9	10
24-31	20	766.8	0	22	172	10	54	11	11	196	54	0
JUNE	1978											
1-7	21	64.8	0	0	192	0	0	0	0	153	0	0
8-15	22	648.0	0	0	130	0	0	0	0	518	130	0
16-23	23	1,101.16	112	0	963	75	204	0	0	130	64	0
	24	0	—	—	—	—	—	—	—	—	—	—
JULY	1978											
1-7	25	1,328.4	0	0	411	0	0	0	26	26	0	26
8-15	26	—	—	—	—	—	—	—	—	—	—	—
16-23	27	0	—	—	—	—	—	—	—	—	—	—
24-31	28	1,806.0	0	51	1,708	0	34	0	17	1,110	34	17

Table 3. (Continued)

Date	Period	Effort (Man-Hrs.)	No. Specs	No. Sdtrt	No. Crkrs	No. Rdfs	No. Drum	No. Fld	No. Spsh	No. Sct	No. Gftp	No. Oth
AUGUST	1978											
1-8	29	1,055.7	148	33	1,236	22	55	118	11	385	22	0
9-16	30	976.2	0	0	1,355	0	0	0	0	0	0	96
17-24	31	844.2	98	116	325	39	90	13	13	271	39	0
25-31	32	0	—	—	—	—	—	—	—	—	—	—
SEPTEMBER	1978											
1-6	33	336.0	0	0	85	0	85	85	28	28	0	113
7-14	34	151.2	0	13	0	0	13	25	0	13	0	75
15-22	35	725.4	1,510	41	69	0	41	0	28	122	0	20
23-30	36	2,637.0	840	0	88	190	44	59	0	176	0	0
OCTOBER	1978											
1-8	37	610.7	540	0	66	0	0	0	25	0	0	25
9-15	38	1,342.4	657	68	0	0	0	68	0	0	0	0
16-23	39	0	—	—	—	—	—	—	—	—	—	—
24-31	40	825.0	241	0	0	0	0	0	0	0	0	0
NOVEMBER	1978											
1-8	41	0	—	—	—	—	—	—	—	—	—	—
9-16	42	2,386.8	3,428	0	114	0	199	28	10	0	0	0
17-24	43	803.3	1,102	0	90	0	30	0	0	0	0	0
25-31	44	0	—	—	—	—	—	—	—	—	—	—
DECEMBER	1978											
1-8	45	660.0	158	0	264	0	0	79	26	0	0	26
9-16	46	771.8	3,297	0	0	0	0	0	0	37	0	0
17-24	47	529.2	251	0	0	0	0	0	0	0	0	0
25-31	48	940.8	284	0	0	0	0	0	0	32	0	0
JANUARY	1979											
1-7	1	0	—	—	—	—	—	—	—	—	—	—
8-15	2	105	0	0	0	0	0	0	0	0	0	0
16-23	3	0	—	—	—	—	—	—	—	—	—	—
24-31	4	0	—	—	—	—	—	—	—	—	—	—
FEBRUARY	1979											
1-7	5	0	—	—	—	—	—	—	—	—	—	—
8-15	6	0	—	—	—	—	—	—	—	—	—	—
16-22	7	0	—	—	—	—	—	—	—	—	—	—
23-28	8	0	—	—	—	—	—	—	—	—	—	—
MARCH	1979											
1-8	9	0	—	—	—	—	—	—	—	—	—	—
9-16	10	0	—	—	—	—	—	—	—	—	—	—
17-24	11	216	0	0	0	0	0	0	0	0	0	0
25-31	12	744	0	0	8	0	0	0	0	0	0	0
APRIL	1979											
1-8	13	510.3	0	0	0	0	0	0	0	0	0	100
9-15	14	0	—	—	—	—	—	—	—	—	—	—
16-22	15	0	—	—	—	—	—	—	—	—	—	—
23-30	16	301.5	15	0	250	0	0	0	0	44	0	0
MAY	1979											
1-8	17	163.2	0	0	20	0	0	0	0	0	0	0
9-16	18	163.2	0	0	189	0	0	0	0	41	0	0
17-24	19	42.0	0	0	11	0	0	0	0	0	0	0
25-31	20	319.5	0	0	29	0	0	0	0	0	29	0

Table 3. (Continued)

Date	Period	Effort (Man-Hrs.)	No. Specs	No. Sdtrt	No. Crkrs	No. Rdfs	No. Drum	No. Fld	No. Spsh	No. Sct	No. Gftp	No. Oth
JUNE	1979											
1-8	21	0	—	—	—	—	—	—	—	—	—	—
9-16	22	194.4	0	0	29	0	30	0	0	0	0	30
17-23	23	259.2	0	0	0	0	0	0	0	89	0	0
24-31	24	75.6	0	0	0	0	0	0	0	0	0	0
JULY	1979											
1-7	25	648.0	0	0	790	0	0	0	0	320	43	64
8-15	26	0	—	—	—	—	—	—	—	—	—	—
16-23	27	0	0	79	0	0	0	72	90	18	0	
24-31	28	0	—	—	—	—	—	—	—	—	—	—
AUGUST	1979											
1-8	29	538.2	0	0	554	0	68	0	0	158	135	23
9-15	30	0	—	—	—	—	—	—	—	—	—	—
16-23	31	0	—	—	—	—	—	—	—	—	—	—
24-31	32	198	0	0	104	0	63	21	21	42	21	21
SEPTEMBER	1979											
1-7	33	633.6	0	0	617	20	239	0	40	40	0	100
8-14	34	0	—	—	—	—	—	—	—	—	—	—
15-22	35	1,015.7	0	138	789	165	0	69	0	82	0	14
23-30	36	720.0	0	47	567	0	94	0	47	188	0	47

Table 4
Total Recreational Effort and Harvest By Species, By Month

Year	Month	Effort (Man-Hrs.)	No. Specs	No. Sdtrt	No. Crkrs	No. Rdfs	No. Drum	No. Fld	No. Spsh	No. Sct	No. Gftp	No. Oth
1977	OCT	8,152.2	5,667	47	695	183	377	183	75	137	281	505
	NOV	5,286.8	0	58	74	22	7	140	80	0	0	
	DEC	2,190.8	772	80		84	0	160	0	27	0	15
1978	JAN	810.0	1,249	0	216	0	0	0	0	0	0	0
	FEB	247.2	0	0	0	0	0	0	100	0	0	0
	MAR	1,952.4	0	0	221	0	272	100	88	183	0	267
	APR	2,391.6	70	123	579	0	482	12	11	113	18	0
	MAY	3,481.2	0	22	2,220	119	273	30	60	705	63	10
	JUNE	1,814.4	112	1,285	75	204	0	0	801	194	0	
	JULY	3,134.4	0	51	2,119	0	34	0	43	1,136	34	43
	AUG	2,879.1	149	2,916	61	145	131	24	656	61	96	
	SEPT	3,849.6	2,350	54	242	190	183	169	56	339	0	208
	OCT	2,778.1	1,438	68	66	0	0	68	25	0	0	25
	NOV	3,190.1	4.350	0	204	229	28	10	0	0	0	
	DEC	2,901.8	3,990	0	264	0	0	79	26	69	0	26
1979	JAN	105.0	0	0	0	0	0	0	0	0	0	0
	FEB	0	—	—	—	—	—	—	—	—	—	—
	MAR	960.0	0	0	0	0	0	0	0	0	0	0
	APR	811.8	15	0	250	0	0	0	0	44	0	100
	MAY	818.7	0	0	249	0	0	0	0	41	29	0
	JUNE	529.2	0	0	29	0	30	0	0	89	0	30
	JULY	818.4	0	0	862	0	0	0	72	410	61	64
	AUG	736.2	0	0	658	0	131	21	21	200	156	44
	SEPT	2,369.3	0	185	1,973	185	333	69	87	310	0	161

Table 5.

Total Effort, Harvest, and Count Per Pound For White Shrimp and Brown Shrimp Taken Commercially and Recreationally By Period Within The Study Area For The Two-Year Study Period (Data Expanded From Interviews)

		RECREATIONAL					COMMERCIAL				
Month	Period	Effort (Trawl Hrs.)	Avg. Count White (Heads On)	Lbs. White (Heads On)	Avg. Count Brown (Heads On)	Lbs. Brown (Heads On)	Effort (Trawl Hrs.)	Avg. Count White (Heads On)	Lbs. White (Heads On)	Avg. Count Brown (Heads On)	Lbs. Brown (Heads On)
OCTOBER	1977										
1-8	37	1,663	48	15,810	—	0	3,326	61	134,290	—	0
9-15	38	2,055	54	39,917	—	0	3,441	55	132,319	—	0
16-23	39	1,115	63	140,550	—	0	1,438	79	163,043	—	0
24-31	40	930	59	5,911	—	0	154	55	768	—	0
NOVEMBER	1977										
1-7	41	79	75	285	—	0	119	55	768	—	0
8-15	42	200	58	1,673	—	0	0	—	—	—	—
16-22	43	0	—	—	—	—	38	75	228	—	0
23-30	44	0	—	—	—	—	0	—	—	—	—
DECEMBER	1977										
1-8	45	45	69	269	—	0	0	—	—	—	—
9-16	46	0	—	—	—	—	0	—	—	—	—
17-23	47	0	—	—	—	—	0	—	—	—	—
MAY	1978										
24-31	20	31,116	33	227,286	183	159,823	21,263	38	143,812	200	147,524
JUNE	1978										
1-7	21	188	—	0	125	2,453	188	—	0	125	1,225
8-15	22	992	30	325	71	7,606	592	26	504	66	12,525
16-23	23	403	10	21	44	3,548	2,004	55	3,990	59	44,907
24-30	24	687	—	0	39	4,954	229	—	0	45	2,612
JULY	1978										
1-7	25	0	—	—	—	—	0	—	—	—	—
8-15	26	0	—	—	—	—	0	—	—	—	—
AUGUST	1978										
25-31	32	930	33	9,631	—	0	197	28	2,976	—	0
September	1978										
1-6	33	325	36	1,618	—	0	77	33	1,485	—	0
7-14	34	215	28	1,859	—	0	293	36	4,503	—	0
15-22	35	263	36	1,002	—	0	293	36	2,215	—	0
23-30	36	—	—	—	—	278	54	2,224	—	0	
OCTOBER	1978										
1-8	37	478	36	1,002	—	0	117	36	2,215	—	0
9-15	38	34	65	409	—	0	117	36	1,131	—	0
16-23	39	302	22	349	—	0	0	—	—	—	—
24-31	40	0	—	—	—	—	132	36	1,333	—	0
NOVEMBER	1978										
1-8	41	0	—	—	—	—	0	—	—	—	—
9-16	42	0	—	—	—	—	281	80	559	—	0
17-23	43	0	—	—	—	—	0	—	—	—	—
24-30	44	0	—	—	—	—	0	—	—	—	—

Table 5. (continued)

		RECREATIONAL					COMMERCIAL				
Month	Period	Effort (Trawl Hrs.)	Avg. Count White (Heads On)	Lbs. White (Heads On)	Avg. Count Brown (Heads On)	Lbs. Brown (Heads On)	Effort (Trawl Hrs.)	Avg. Count White (Heads On)	Lbs. White (Heads On)	Avg. Count Brown (Heads On)	Lbs. Brown (Heads On)
DECEMBER	**1978**										
1-8	45	0	—	—	—	—	0	—	—	—	—
9-16	46	0	—	—	—	—	0	—	—	—	—
17-24	47	44	—	0	20	20	0	—	—	—	—
MAY	**1979**										
17-24	19	105	38	543	—	0	0	—	—	—	—
25-31	20	149	30	402	—	0	0	—	—	—	—
JUNE	**1979**										
1-8	21	0	—	—	—	—	0	—	—	—	—
9-12	22	130	30	54	—	0	0	—	—	—	—
17-23	23	130	30	86	—	0	0	—	—	—	—
24-30	24	86	30	26	—	0	0	—	—	—	—
JULY	**1979**										
1-7	25	0	—	—	—	—	0	—	—	—	—
AUGUST	**1979**										
16-23	31	0	—	—	—	—	0	—	—	—	—
24-31	32	396	38	3,077	46	526	99	38	770	46	132
SEPTEMBER	**1979**										
1-7	33	230	40	2,327	—	0	0	—	—	—	—
8-14	34	38	50	172	—	0	0	—	—	—	—
15-22	35	528	36	5,070	—	0	158	—	0	—	0
23-30	36	270	40	1,530	—	0	0	—	—	—	—

Table 6.
Total Effort, Harvest, and Count Per Pound For White Shrimp and Brown Shrimp Taken Commercially and Recreationally by Month Within The Study Area For The Two-Year Study Period (Data Expanded From Interviews)

	RECREATIONAL					COMMERCIAL				
Year Month	Effort Trawl Hrs.)	Avg. Count White (Heads On)	Lbs. White (Heads On)	Avg. Count Brown (Heads On)	Lbs. Brown (Heads On)	Effort (Heads Hrs.)	Avg. Count White (Heads On)	Lbs. White (Heads On)	Avg. Count Brown (Heads On)	Lbs. Brown (Heads On)
977										
CT.	5,763	56	201,468	—	0	8,358	63	430,420	—	0
OV.	279	66	1,958	—	0	157	65	979	—	0
EC.	45	59	269	—	0	0	—	—	—	—
978										
AY	31,116	33	227,286	183	159,823	21,263	38	143,812	200	147,524
JNE	2,271	20	346	70	18,561	3,014	41	4,494	74	61,269
JLY	0	—	—	—	—	0	—	—	—	—
UG.	930	33	9,631	—	0	197	28	2,976	—	0
EPT.	803	33	4,479	—	0	283	45	3,955	—	0
CT.	814	41	4,939	—	0	283	45	3,955	—	0
OV.	0	—	—	—	—	281	80	559	—	0
EC.	44	—	0	20	20	0	—	—	—	—
979										
AY	254	34	945	—	0	0	—	—	—	—
JNE	0	30	166	—	0	0	—	—	—	—
JLY	0	—	—	—	—	0	—	—	—	—
UG.	396	38	3,077	46	526	99	38	769	46	131
EPT.	1,066	42	9,099	—	0	158	—	0	—	0

Table 7
Size of Trawl Used, By Percent, By Commercial and Recreational Shrimpers in the Study Area

Trawl Size (feet)	Sport (%)	Commercial (%)
16	4	0
20	1	0
24	1	0
25	9	0
26	2	0
28	2	0
30	19	9
32	2	0
33	1	0
35	24	7
36	0	1
37	3	2
38	2	0
40	22	20
42	1	2
43	1	2
44	0	2
45	2	7
46	0	1
47	0	1
48	1	13
49	1	2
50	2	31

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